Pulse Shape Measurement Option BN 4528/00.03

Operating Manual

BN 4528/00.89

Wandel & Goltermann
Electronic Measurement Technology

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Operating Manual

Pulse Shape Measurement Option
BN 4528/00.03

For software version 02.00...

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the end of this manual.

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1 Introduction

Pulse Shape Measurement is a software option for the Wandel & Goltermann DSA–15 DS1/Signaling Analyzer that permits the user to see an averaged line pulse waveform of a DS1 PCM bit stream. This enables the detection of a marginal signal even though it may not be sufficiently faulty to cause bit errors. Alternatively it may be used to observe the waveform of an error–prone link to help ascertain the cause of its poor performance.

1.1 OVERVIEW

1.1.1 STANDARD PULSE SHAPES

The figures below illustrate the standard limits as specified in the American National Standards specifications T1.102 (Bellcore CB119, new and old) and T1.403 relevant to the pulse shapes measured by the option.

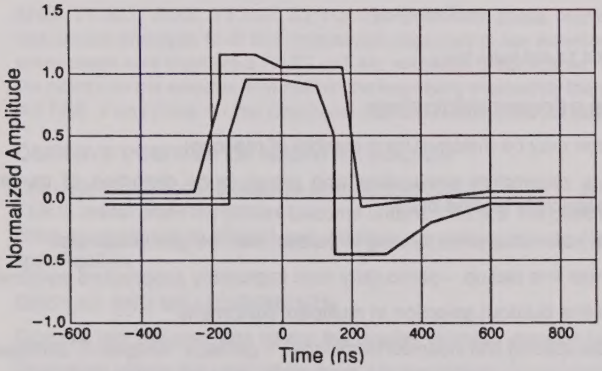


Figure 1.1–1 ANSI T1.102/Bellcore CB119 (new) Pulse Limits

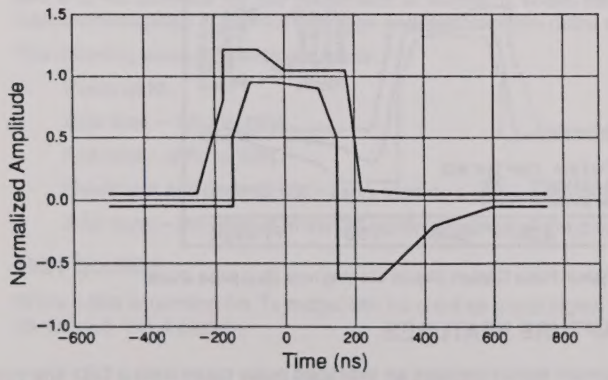


Figure 1.1–2 ANSI T1.102/Bellcore CB119 (old) Pulse Limits

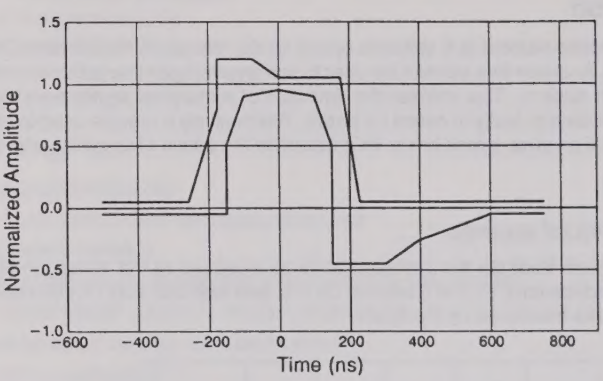


Figure 1.1–3 ANSI T1.403 Pulse limits

1.1.2 HOW PULSES BECOME DISTORTED

The pulse shape may be distorted for a number of reasons:

- Frequency dependent attenuation and group delay distortion of transmission cables, especially twisted pairs.
- Crosstalk from other pairs running in parallel with the pair under test.
- 60Hz power line pickup – particularly from improperly suppressed equipment.
- Incorrect line buildout selection in multiplex equipment.
- Poor cable splicing and incorrect termination – perhaps 'bridged–T' configurations.

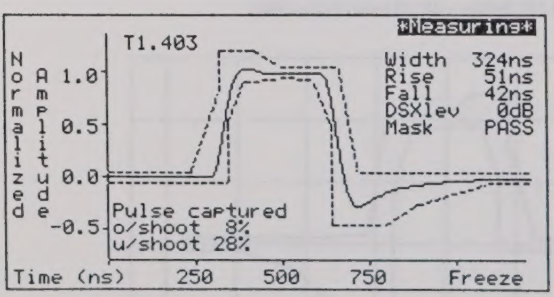


Figure 1.1–4 Typical Pulse Capture display showing near ideal pulse shape

1.2 PULSE CAPTURE FEATURES

The pulse capture option displays an averaged pulse taken from a DS1 line connected to RxA. The RxB connections on the instrument are not used in this option.

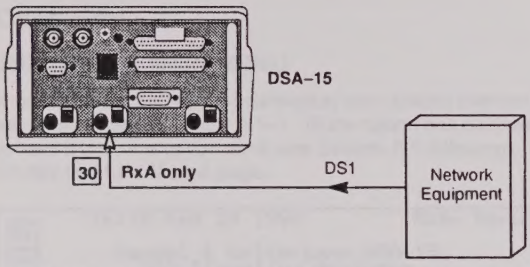


Figure 1.2–1 Connection when using the Pulse Capture Option (terminated)

1.2.1 CHOICE OF PULSE MASKS

ANSI T1.403, ANSI T1.102, CB119 Old and New pulse masks are available. The instrument attempts to fit the normalized captured pulse waveform against the chosen pulse mask and displays a PASS or FAIL message if applicable. A pulse will PASS if all the points on the waveform fall within the boundary marked by the pulse mask. The pulse will FAIL if any point on the displayed waveform falls on or outside the mask.

1.2.2 OBSERVE POSITIVE OR NEGATIVE PULSES

The user can choose to observe an averaged positive pulse or averaged negative pulse. This is useful when the pulses become unbalanced (i.e. the positive and negative pulses differ in amplitude or shape) and either pulse polarity can be checked against a pulse specification.

1.2.3 DISPLAY AND MEASUREMENTS

During a test the user can freeze the display for more detailed inspection.

Messages inform the user when there are insufficient recognisable pulses (Bad signal). If there are not enough zeros then one pulse affects another (inter–symbol interference) and it is not possible for the instrument to display a whole pulse. In this case the instrument displays a warning message and truncates the pulse display.

The following measurements are made:

- Pulse width.
- Rise time – 10% to 90%.
- Fall time – 90% to 10%.
- Overshoot and undershoot – expressed as a percentage of the height of the pulse.
- DSX level – dB relative to the 3V nominal voltage of the pulse.

1.2.4 TEST SOURCE

While a test is running the Tx output can be used as a test signal source, transmitting a continuous 1 in 4 pattern.

2 Operation

2.1 THE DSA–15 MAIN MENU

If the Pulse Capture option has already been loaded then the **{Main Menu}** of the DSA–15 will be as shown in Figure 2.1–1. (If the option has not been loaded it will be necessary to load it from the option card, see Section 2.2 following). Press **<Select>** to enter the **{Pulse Capture Menu}** page.

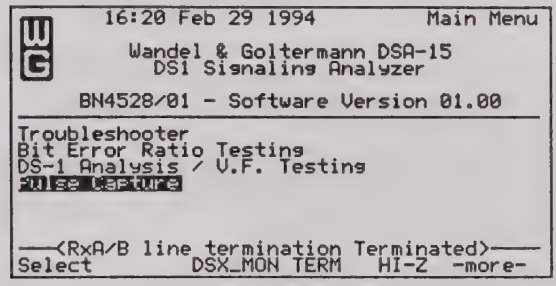


Figure 2.1–1 DSA–15 Main Menu with Pulse Capture Option Loaded

2.2 LOADING THE OPTION FROM MEMORY CARD

Section 3.4 of the DSA–15 Operating Manual describes the process of loading an option from a ROM card. This section presents a summary of the loading procedure.

Switch on the instrument and insert the ROM card containing the option. Press **<–more–>** then **<Load>** on the **{Main Menu}** and the **{Load option from device}** menu will be displayed. The top right–hand corner will display either **CARD:** or **LINK:**. If it shows **LINK:** then press **<Device>** and change the current device to **CARD:**. The name of the option on the card should be displayed. If there are several loadable options on the card they can be stepped through using the **<Prev>** or **<Next>** softkeys.

The following softkeys are available:

<Load>	Loads the selected option.
<Device>	Allows options to be loaded from other devices (for example by way of the serial port **[25]**).
<ID>	Displays the unique identity number associated with the instrument.
<Prev>/<Next>	If multiple options are stored on the same card then these keys allow the user to step through them.

If there is a problem then one of the following messages may be displayed:

Device not responding – The memory card could not be accessed. Check that it is correctly inserted.

Device not formatted – The memory card is not a format recognized by the DSA–15. Check that it is the correct card.

No option present – The memory card is recognized by the DSA–15 but there are no loadable options on it. Check that it is the correct card.

When the pulse capture option has been located the display will be similar to the following:

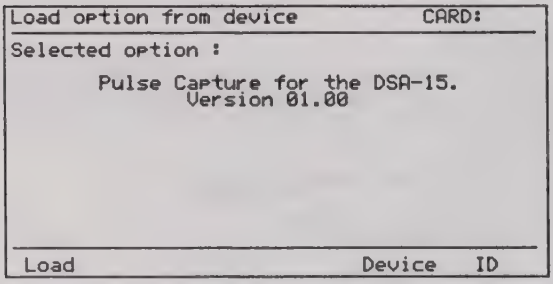


Figure 2.2–1 {Load option from device} display

Press <**Load**> to load the option. If the display shown in Figure 2.2–2 appears then there is not enough space in the flash ROM memory of the instrument to store the option and *all* the options in the instrument must be erased. For this reason it is important to keep the original cards on which the options were supplied.

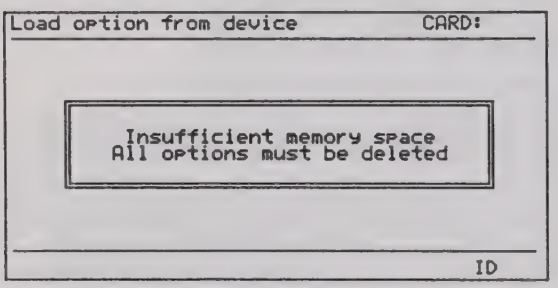


Figure 2.2–2 'Insufficient space' display

If there are no problems then the instrument will display a prompt for the access code to be entered. This code is unique to the combination of the software version and individual instrument serial no. and will have been provided when the option was supplied. Once the code has been correctly entered the option will begin loading. Do not switch the instrument off during the loading process or the option memory will be corrupted and it may be necessary to reload all the options previously stored.

Once the option has been loaded the **{Main Menu}** should reappear with the selection **Pulse Capture** available.

2.3 CHOICE OF TEST PATTERN

The pulse capture option is designed to be able to make measurements from any bit patterns with a sufficient ones density. Accurate measurements are possible from most bit patterns, for example live traffic, but where it is acceptable to change the pattern being measured optimum results can be gained by careful choice of pattern. The pattern available on the Tx is ideal for making pulse measurements, (01000100 repeating).

For best results choose a pattern with plenty of well–isolated pulses, for example 1 in 8 (1:7) or 3 in 24. Failing these, PRBS patterns or 1 in 2 can be used. Inferior results (due to pulse truncation) will be noted in the case of all zeros (B8ZS only), 55 octets or all ones.

The presence or absence of framing will not significantly affect the performance of pulse capture.

2.4 THE PULSE CAPTURE TOP–LEVEL MENU

This is the first menu that is displayed after selecting the **Pulse Capture** mode from the DSA15 **(Main Menu)**.

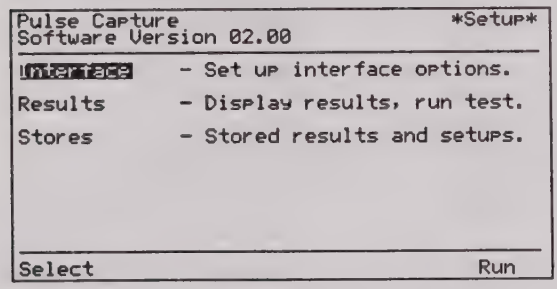


Figure 2.4–1 The Pulse Capture top level menu

This top layer menu provides access to the pulse capture setup pages and allows a test to be run.

There are two softkey functions available on this menu page:

<Select> Select the field covered by the highlight bar.

<Run> Run test using the current instrument setup.

2.5 THE PULSE CAPTURE INTERFACE PAGE

On selecting the **Interface** option from the **(Pulse Capture)** menu, the **(PLS: Interface page)** will be displayed.

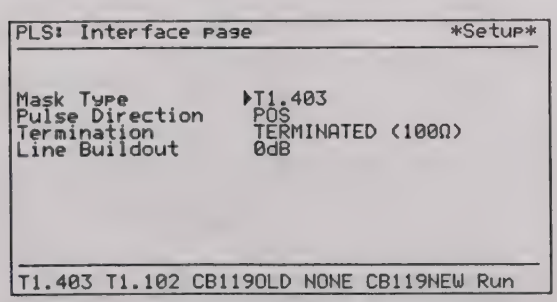


Figure 2.5–1 The (PLS: Interface page *Setup*) display

This menu allows the user to make the following choices:

- Selecting the Pulse Mask
- Setting the pulse polarity to be displayed
- Setting the Termination
- Running the test.

The following fields and options are available:

Field	Softkey	Comments
Mask Type		Allows the user to select the appropriate pulse mask overlay:
	<T1.403>	ANSI T1.403 mask.
	<T1.102>	ANSI T1.102 mask.
	<CB119OLD>	Bellcore CB119, old.
	<NONE>	No mask overlay.
	<CB119NEW>	Bellcore CB119, new.
Pulse Direction	**<Pos.>**	Capture positive pulses only.
	<Neg.>	Capture negative pulses only.
Termination	**<TERM>**	Terminates the line into 100Ω to provide correct impedance matching. This gives the most accurate display of pulse shape and is the termination mode that should be used for testing a pulse shape against a mask.
	<DSX_MON>	Terminates the line into 100Ω with gain to allow for connection to protected monitor points. (Note that the DSX level display accuracy will be dependent on the external components at the protected monitor point). The external bridging circuit is assumed to consist of 432Ω, ±5% resistors connected to tip and ring.
	<HI–Z>	High (1kΩ nominal) impedance for connection across an already terminated circuit.
	<Run>	(This softkey option appears in all the above fields) Runs the test from here. Connect the signal source under test to **RxA [30]** and press **<Run>** to start the pulse capture process. The display will change to something similar to that below.
Line Buildout	**<0dB>, <7.5dB>, <15dB>**	This provides a user–selectable line buildout (attenuation).

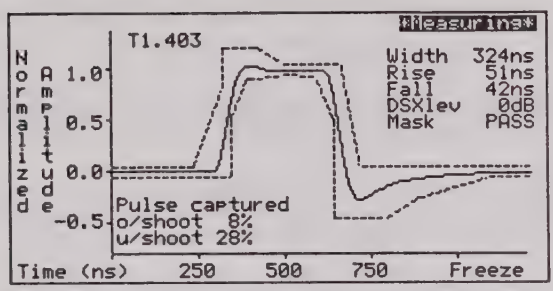


Figure 2.5–2 Showing a near–ideal pulse against the ANSI T1.403 mask

2.6 THE PULSE CAPTURE DISPLAY AND MEASUREMENTS

This page is displayed when **<Run>** is pressed or results is selected from the top level menu. If **<Run>** was pressed the test will begin immediately but if this page was entered by selecting results the display will show the last pulse to have been captured or loaded from the stores.

2.6.1 DISPLAY

The pulse display is normalized so that the centre of the top of the pulse is at 1.0 on the displays vertical scale. Rise, fall, overshoot and undershoot measurements are all relative to this pulse height. Where a measurement is out of range the symbol '>>>' will replace the figures.

2.6.2 MEASUREMENTS

2.6.2.1 Pulse width

Pulse width is measured from the 50% level at the start of the pulse to the 50% level at the end.

2.6.2.2 Rise time and fall time

The rise and fall times are the time for the voltage to rise from 10% to 90% and to fall from 90% to 10% of the pulse height respectively.

2.6.2.3 Overshoot and undershoot

These are the maximum and minimum points of the pulse expressed as a percentage of the height of the pulse.

2.6.2.4 DSX level

The DSX level is the level of the input signal relative to the 3V nominal pulse height, expressed in dB.

2.6.3 WARNING MESSAGES

2.6.3.1 Insufficient zeros

This is displayed if there are not enough isolated pulses (e.g. 010) in the data stream. Because consecutive pulses interfere with one another the instrument only displays the

pulse itself, not the surrounding trace as usual, and displays the warning **'Not enough isolated pulses'**.

2.6.3.2 Bad signal

If the signal is so poor that the instrument is unable to discern enough pulses to build up a picture, or there is little or no signal present on the RxA, the instrument displays **'Bad Signal'**.

Note: A signal displayed as a **'Bad Signal'** during pulse shape measurement may in fact be received and decoded correctly in other test modes. This is because the signals may require line equalisation which is not applied during pulse shape measurement.

2.6.4 FREEZE

Pressing **<S6>** stops the pulse capture and holds the display so that it can be examined more closely. To indicate that the pulse capture has been interrupted, the message in the top, right corner of the display changes to **'Frozen'**. Press **<S6>** again to continue the pulse capture procedure.

2.6.5 PRINT

The **[PRINT]** key will send a copy of the display to a printer or terminal. This includes all the measurements made from the pulse, although the pulse itself will only be printed if a graphics printer is selected from the **{Printer Menu}**, (see Section 2.10 of the main DSA–15 Operating Manual).

2.7 THE PULSE CAPTURE STORES PAGE

2.7.1 OVERVIEW

Set–up and results data can be transferred between the instrument and a memory card or PC by using the **{Pulse Capture: Stores}** menu. Before entering this menu ensure that the device hardware is correctly set up. In the case of memory card storage ensure that an SRAM memory card has been plugged into the DSA–15 memory card slot. If data is to be stored on a PC, ensure that the interface cable is installed and that the PC is running the PC_LINK software (see Section 3.5.4 of the main DSA–15 Operating Manual). After setting up the device, the **{PLS: Stores}** menu can be entered by highlighting the **Stores** option on the **Pulse Capture** top level menu and pressing the **<Select>** softkey.

The storage device can be changed by pressing the **<Device>** softkey and selecting the new device name.

The **{PLS: Stores}** menu will always display either a warning message or a list of the files present on the device. If the instrument cannot recognise the directory format then the **'Directory not found'** warning will be displayed. If the memory card storage device is being used then this message indicates either the absence of a card or the presence of an incorrectly formatted card. The memory card can be formatted by pressing the **<Format>** softkey. The **'Directory not found'** warning indicates a problem with the link setup when a PC is being used as the storage device.

All Pulse Capture files are marked with a .PLS file extension. If the selected device is formatted correctly but contains no files with the .PLS extension then the instrument will display the **'No files matching *.PLS'** warning.

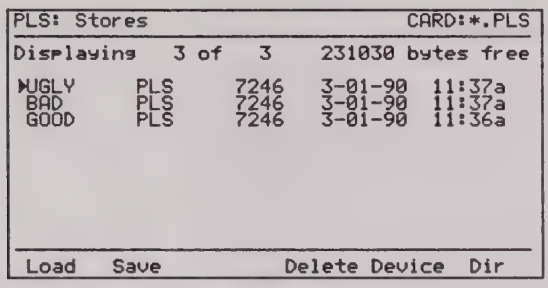


Figure 2.7–1 A typical {Pulse Capture: Stores} menu

The **{PLS: Stores}** menu includes a directory viewer which shows a list of all the files in the current directory with names that match a pre–defined template. The device name and template are shown in the top right hand corner of the display. The default template is set to *.PLS on entry.

Files can be selected from the list of displayed filenames by moving the arrow cursor up and down the list using the [△] and [▽] cursor keys. The [◁] and [▷] cursor keys scroll forward and backward through the directory list one page at a time.

The softkeys define the actions that can be performed on a selected file and these actions are summarised below.

Softkey:	**Action:**
<Save>	Save the instrument setup and results in the selected file, see Section 2.7.3.
<Load>	Load the instrument setup or the instrument setup and results from the selected file, see Section 2.7.4.
<Delete>	Delete the selected file. See Section 2.7..5.

File selection using the arrow cursor provides a quick way of specifying an existing file for an action to be performed. Files can be selected by name after pressing any of the file action keys and by using the file name editor. This is particularly useful for creating new files when saving.

2.7.2 THE FILENAME EDITOR

Figure 2.7–2 shows the filename editor in a typical application.

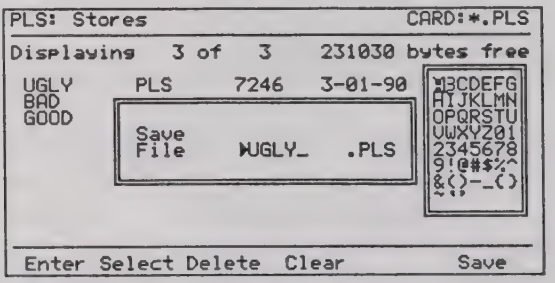


Figure 2.7–2 A typical Filename Editor display

The filename editor is entered by pressing **<Edit>** and can be used to specify any valid eight character filename. The box on the right hand side of the screen contains all available file name characters. In edit mode, characters are selected from this box using the block cursor. Block cursor movement is controlled by the cursor keys **[6]** and highlighted characters can be appended to the file name by pressing the **<Select>** softkey. Characters entered on the hexadecimal keypad are also appended to the filename. The edit mode softkey actions are summarised below.

Softkey:	**Function:**
<Enter>	Enter the new filename and exit from the filename editor.
<Select>	Copy the selected letter from the letter selection box and append it to the filename.
<Delete>	Delete the last letter in the filename.
<Clear>	Delete the entire filename.
<Save>	Save the instrument set–up and results into the named file.

2.7.3 SAVING INSTRUMENT SETUP AND RESULTS

Test results and the associated instrument set–up can be saved together in a single file by pressing the **<Save>** softkey. Figure 2.7–3 shows the Save menu.

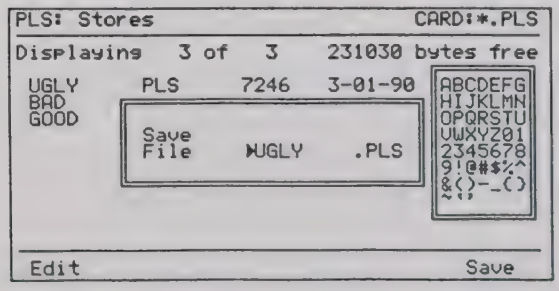


Figure 2.7–3 Save display

The contents of the filename field can be altered using the filename editor described in Section 2.7.2.

2.7.4 FILE LOADING

Instrument setup and results can be loaded from a file by pressing **<Load>**. The load file can be selected from the directory viewer or specified using the file name editor. In practice it is more convenient to select the file using the arrow cursor before pressing **<Load>**.

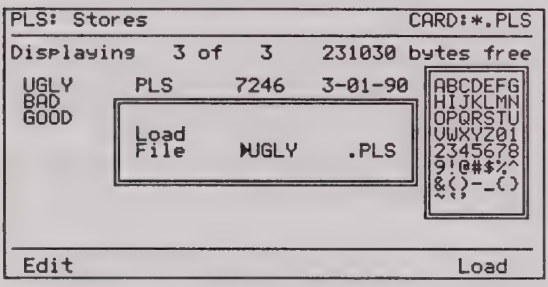


Figure 2.7–4 Load menu

Figure 2.7–4 shows the load sub–menu. The **<Load>** softkey must be pressed to confirm loading. Error messages report any problems that occur during the loading process.

2.7.5 DELETING FILES

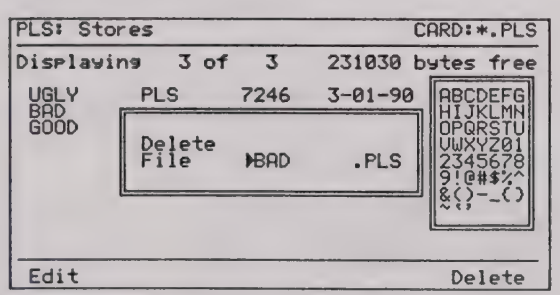


Figure 2.7–5 Delete menu

Files can be selected for deletion from the directory viewer list by using the cursor keys and then deleted by pressing **<Delete>**. Alternatively, the **<Delete>** softkey can be pressed and the name of the target file can be specified using the filename editor.

Figure 2.7–5 shows the Delete sub–menu. The **<Delete>** softkey must be pressed to confirm file deletion. Error messages report any problems.

2.7.6 CHANGING THE DIRECTORY TEMPLATE

The directory template acts as a filename mask to enable only specific files to be displayed according to their file extension or name.

The directory template can be changed by pressing the **<Dir>** softkey.

The directory template edit box then appears on the screen showing the current template name. This takes the form of a filename and a three character extension (which will normally be set to PLS for this test mode). The template name may be edited as for filenames described in Section 2.7.2. The * character acts as a wild card and can be used to represent a sequence of characters.

The **<*.*>** softkey will cause all files to be displayed in the directory whereas pressing **<*.PLS>** will only allow files with the PLS extension to be visible.

2.7.7 CHANGING THE CURRENT DEVICE

Before changing the device, ensure that the device (i.e. memory card or PC link) is set up correctly. For the memory card, make sure an SRAM card is inserted into the card slot **[A]** on the side of the DSA–15. For the PC link, ensure that the serial link cable is connected to the PC and that the PC is running the PC_LINK software.

To change the current device, press the **<Device>** softkey in the **{Stores}** menu and select the required device (memory card or PC link).

3 Applications

3.1 COMMISSIONING NEW EQUIPMENT

When commisioning new equipment the Pulse Capture Option can be used to check the following:

- The output pulse of new network equipment such as multiplexers and CSUs can be checked for compliance with pulse mask specifications. The rise times and pulse imbalance (+ve and –ve pulse comparison) can be monitored.
- Terminations and line buildout selections can be verified.
- Long cable runs can be checked to see whether repeaters are necessary. (Particularly useful in high rise buildings where the length of a cable run may be difficult to estimate).

3.2 TROUBLESHOOTING EXISTING NETWORK EQUIPMENT

Troubleshooting can be carried out on already installed equipment using the pulse capture facility as follows:

- Quick comparisons of T1 signals can be made where line attenuated signals are 'well out of specification'. These signals will probably not meet the pulse mask requirements but a known 'good' signal can be compared with a 'bad'.
- Detection of faulty repeaters, line termination, poor cable splices etc.
- Location of long cable runs without a repeater.

3.3 EXAMPLE WAVE SHAPES

3.3.1 WRONG CABLE IMPEDANCE

The marginal pulse shown below resulted from feeding the signal through a short length of cable of inappropriate impedance.

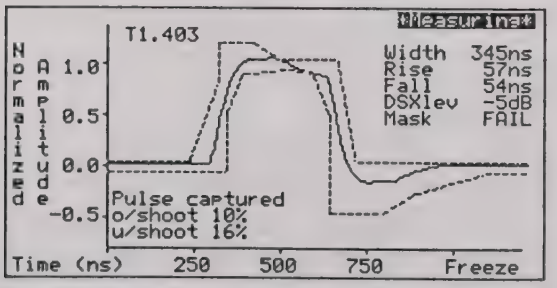


Figure 3.3–1 Marginal pulse due to inappropriate impedance matching

3.3.2 UNTERMINATED LINE

This measurement was made from a protected monitor point connected to a short line that was unterminated.

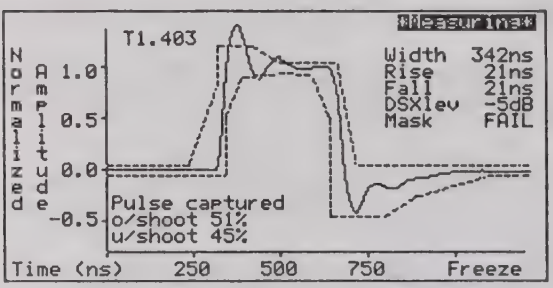


Figure 3.3–2 Out of tolerence pulse due to an unterminated line

3.3.3 LONG CABLE RUN

This display below was produced by monitoring the remote end of a length of twisted–pair cable.

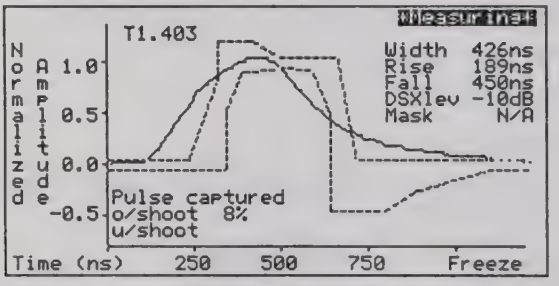


Figure 3.3–3 Out of tolerence pulse due to line distortion

3.3.4 POWER LINE DERIVED INTERFERENCE

Power line induced 60Hz hum is not usually a problem for T1 equipment as it is outside the bandwidth of most DS1 input transformers. However, high–frequency harmonics are often met on the 60Hz power supply. These are usually caused by poorly suppressed equipment that use switching power control (e.g. lamp dimmers and variable–speed electric drills). Switch–mode power supplies (often found in electronic equipment) can also be a cause of power line–borne interference. Where T1 lines are run alongside power lines this interference can be picked up by the T1 line resulting in transients appearing on the pulse. These harmonics are captured on the waveform in an arbitary manner.

Figure 3.3–4 shows a fairly gross distortion caused by mixing a 60Hz square wave with the signal.

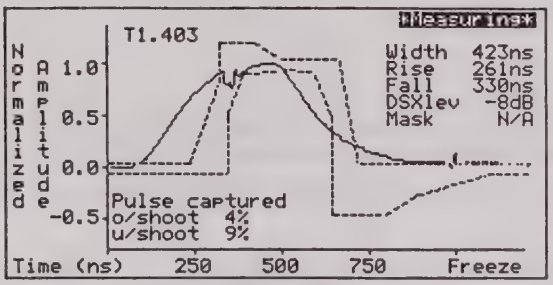


Figure 3.3–4 Distorted pulse due to 60Hz square wave superimposed on input signal

3.3.5 CROSSTALK

Where a pair runs parallel with others it may pick up interference from them, particularly if, as here, the desired signal is already weak and the other pairs are carrying high signal levels. Where the signals are not related (e.g. by a common clock) the interference shows up as noise.

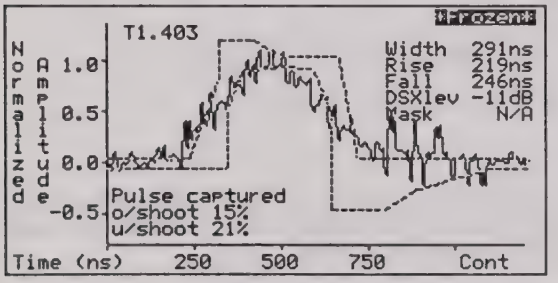


Figure 3.3–5 Noisy and out of tolerance pulse due to crosstalk with an adjacent line

Where the signals are related, in this case by both being based on a common clock, the distortion to the pulse shape may be more unusual, see Figure 3.3–6.

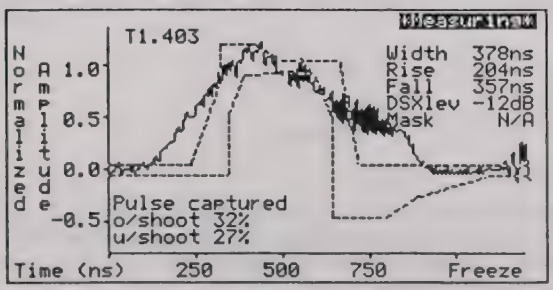


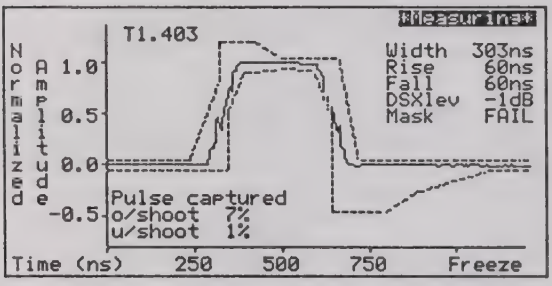
Figure 3.3–6 Noisy and out of tolerance pulse due to crosstalk with an adjacent line synchronized to the same clock as the line under test

The reason for this is that the induced interference pulses always come at the same point in the desired pulse.

3.3.6 JITTER

Jitter will show up on the DSA–15 as distortion around the edges of a pulse. Only where the jitter is extreme will the distortion affect the top of the pulse. In this display shown in Figure 3.3–7 the jitter was at 60kHz with an amplitude of 0.1UI.

Note: The pulse is still acceptable to the network and only the *averaged* pulse is seen to fail the mask.



IFigure 3.3–7 Display showing jitter on the skirts of the pulse

3.3.7 BRIDGE TAPS

In some networks, flexibility in the wiring of a site is obtained by the use of 'bridge taps'. This is where a number of lines are connected in parallel to different locations, with only one destination actually being put into service.

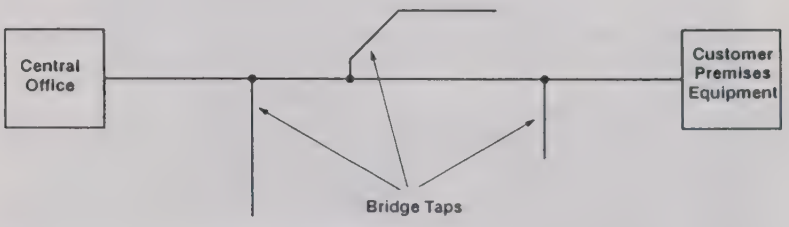


Figure 3.3–8 Showing the principle of Bridge Taps

These unterminated transmission lines cause pulse interference due to signal reflections. An example of such a distorted pulse as measured by the DSA–15 is shown in Figure 3.3–9 below. However, a great variety of pulse distortions can occur dependent on the number, position and length of the bridge taps.

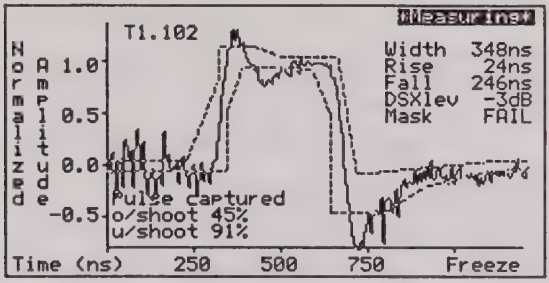


Figure 3.3–9 Example of pulse distortion caused by unterminated bridge taps

4 Troubleshooting

This section suggests possible causes of problems encountered when using the Pulse Capture facility. The information following is *not* to be regarded as a *fault* searching guide for the installed option, the instrument itself or the system to which it is connected.

4.1 PULSE DISTORTED OR LEVEL TOO LOW

One possible cause is that the instrument is set to **TERMINATED** when monitoring an already terminated line or protected monitor point. The best solution is to disconnect the line from the rest of the equipment and allow the DSA–15 to terminate the line. If this is not possible (e.g. the link is carrying live traffic), either connect it via a protected monitor point or **BRIDGE**. Note that the most accurate mask comparisons require the instrument to be in **TERMINATED** mode.

4.2 SEVERE RINGING

This could be caused by having termination set to **BRIDGE** when connected to an unterminated line. Set the termination to **TERMINATED**.

4.3 'BAD PULSE' OR PULSE DISPLAY SEVERELY DISTORTED

The '**Bad Pulse**' message is displayed if there is no recognizable signal. This could be because the line is not properly connected or the signal is at such a low level, or so distorted that the instrument cannot synchronize to it.

Alternatively the signal may be overloading the input, typically because **DSX–MON** termination is selected when monitoring other than a protected monitor point, or **BRIDGE** termination is selected when monitoring an unterminated line. Correct the termination mode and try again.

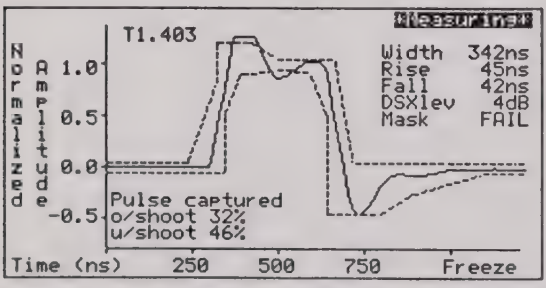


Figure 4.3–1 Pulse distortion due to overloading and incorrect termination

This display above shows the input of the instrument overloading due to a very high signal level combined with ringing due to incorrect termination.

4.4 'INSUFFICIENT ZEROS' – PULSE TRUNCATED

The instrument will display the warning '**Insufficient zeros**' if there are not enough zeros to isolate the pulses (e.g. minimum of 010) in the data stream. Change the test pattern to a more suitable one if possible – 1:7 , 3 in 24 or the signal from Tx are ideal. This problem often occurs on idle lines.

4.5 MASK PASS OR FAIL NOT DISPLAYED

The signal level must be within ±5dB of standard 0dB DSX level to perform a comparison with the pulse mask. If this is not the case then the **Mask** field on the display shows **N/A**. Possible causes include incorrect termination of the line and insufficient zeros to isolate the ones in the data stream. The latter is indicated by the '**Not enough isolated pulses**' message.

4.6 NOT CALIBRATED!

If the DSA–15 displays the message '**NOT CALIBRATED!**' in the top, right corner of the screen the instrument has not been calibrated for the Pulse Capture option. Although it is possible to continue to use the pulse capture facility, measurements will not be accurate. To ensure accurate results the instrument must be returned to a W&G Service centre for re–calibration.

Appendix A – Specifications

The specifications are valid under the nominal operating conditions, unless otherwise stated.

For full specification information on the DSA–15 refer to the main Operating Manual.

A.1 SPECIFICATION OF PULSE CAPTURE OPTION

Linearity	±1%
Amplitude accuracy	±5%
Amplitude resolution	8–bits
Time resolution	20ns
Equivalent bandwidth	17MHz
Pulse masks	ANSI T1.102/CB119 and ANSI T1.403

A.2 ORDERING INFORMATION

Pulse Capture Option for DSA–15	BN 4528/00.03

Appendix D – Glossary

Glossary of terms and acronyms used in this manual.

ANSI ..... American National Standrds Institute

DS1 ..... Cross–Connect Digital Signal Level 1

DSX ..... Digital Signal Cross–Connect

PCM ..... Pulse Code Modulation

PRBS ..... Pseudo Random Bit Sequence

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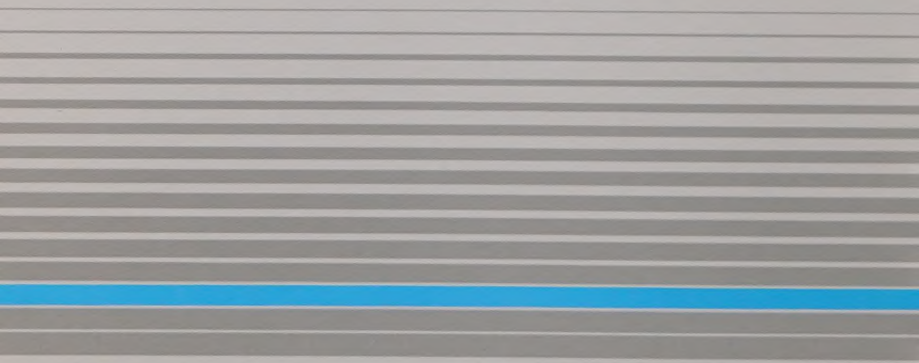

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